

HOW DO RECENT CHANGES IN
TAX LAWS AFFECT INVESTMENT DECISIONS?*

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Current discussion on the possibilities of a reduction in the corporate income tax-rate and recent changes in the law pertaining to depreciation rules¹ together with the investment credit which was introduced in the Revenue Act 1962 pose interesting questions which centre around the general topic of the effect of fiscal measures on business investment decisions. This paper, however, confines itself to the recently legislated investment credit.² In this connection a few comments on the study made by George Terborgh³ of the investment credit's effect on the rate-of-return are offered. Since the payback is a widely used criterion of investment choice a brief analysis of the investment credit's effect on that measure is also offered. Before proceeding to these topics a few preliminary remarks are made concerning the general problem of analyzing the potential effects of fiscal measures on investment decisions.

A priori speculation on whether or not changes in fiscal policy will affect business investment decisions is not possible unless one has

¹ See Depreciation: Guidelines and Rules published by U.S. Treasury Department, I.R.S., publication No. 456 (9/62). An excellent description and appraisal of these new rules may be found in the American Economic Review, Papers and Proceedings, Vol. LIII, May 1963: "Tax Reform: Depreciation Problems," by Norman B. Ture, pp. 334-353.

² For the details the reader should consult Section Two of the Revenue Act 1962. The principal provisions and the points relevant to the discussion presented here are in Appendix A of this paper.

³ New Investment Incentives, Machinery and Allied Products Institute, 1962, by George Terborgh. The formulae underlying this study are contained in "The Econometrics of the New Investment Incentives," (Mimeographed, unpublished), by Eric Schiff.

some notion of how in fact investment decisions are made; and even this kind of knowledge may not be adequate unless the assumption is made that the process itself will not be altered as a result of the fiscal changes. In fact, however, there is very little available which can be regarded as a reasonable and general model of investment behavior. Many studies of business investment decisions have been made but most of these quite naturally tended to focus around particular aspects of the decision-making process and on particular kinds of problems associated with making investment decisions. Thus there is evidence--but none very systematic or representative--on the administrative aspects of capital budgeting, on methods of measurement used, on the treatment of uncertainty and expectations, and so on; but little in the form of a generalized model.⁴

Thus when the question is asked: What will be the effect on investment decisions of a specified change--for example, in the tax-rate on corporate income--there is little available to provide a systematic answer to this problem. Studies have indicated that in fact some firms use pre-tax figures in their computations of investment profitability; some do not.

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See for example the empirical evidence of Donald F. Istvan, "The Economic Evaluation of Capital Expenditures", Journal of Business, Jan., 1961, pp. 45-51; John B. Matthews, "How to Administer Capital Spending", Harvard Business Review, March/April 1959, pp. 87-99. Also see Donald F. Istvan's, Capital-Expenditure Decisions: How they are made in large Corporations, Bureau of Business Research, Graduate School of Business, Indiana University, Report No. 33, 1961.

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Istvan, Capital-Expenditure Decisions, p. 91.

...criticism most studies stress the qualitative and intangible components of investment decision-making. Hence even a firm not using post-tax figures in its computations might react quite strongly to income tax-rate changes not through a change in the investment's payback period, or rate-of-return, or corresponding measures of investment worth but rather through the changes in the qualitative components of the decision which do react to the change in the tax-rate. Even when fiscal changes are introduced the ex post analysis of their effect on investment decisions is still very problematical and difficult to generalize.

These difficulties are well illustrated in the case of the investment credit. A Wall Street Journal survey⁷ of over sixty-eight companies found only one which thought the credit "would have a 'significant' effect on major expansion programs". Thirty-eight of the companies surveyed said that "the credit would at most cause them to take a second look at 'marginal' projects they had rejected, or start early on projects they would eventually have begun anyway". Twenty of the companies claimed "the credit wouldn't change their capital spending plans at all".

Additional surveys by the Wall Street Journal made only a few months later indicated "the new law providing a tax credit of up to 7% for purchases

⁶ Ibid., p. 94-96. See also "The Judgment Factor in Investment Decisions", Harvard Business Review, Volume 39 (March/April 1961) pp. 93-99.

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The three extracts from the Wall Street Journal cited here are from the issues of February 8, November 12, and November 23, 1962, respectively.

of equipment, have given little stimulus so far to business spending plans. A few days later, however, the Wall Street Journal reported the views of machine tool producers who claimed that the tax-credit was an important factor in boosting their orders.

Apart from the varied kinds of reaction reflected in these observations, the problem of determining the effect of the investment credit is complicated by an additional factor, namely, that changes occurred in investment for reasons other than the availability of the investment credit. Disentangling these various factors is not easy.

In brief then we have the related facts: first that general models descriptive of actual decision-making in this important managerial function do not exist and, second, that actual investment behavior as a reaction to changes in the parameters of investment decisions is difficult to generalize or even specify.

Despite these lugubrious remarks efforts must be made to analyze the effects on capital expenditure decisions of changes in, among other things, the relevant tax rules. Earlier we hinted at the rough dichotomy between the quantitative aspects of these decisions and the judgmental shading of the quantitative analysis. The quantitative component of the decision usually culminates in the computation of an index of profitability which can be expressed as either a payback period, or a rate-of-return, or one of many

other criteria currently in use. In the discussion of the effect of the investment credit which follows the impact of the credit only in so far as it affects the quantitative component of investment decisions is analyzed. The important, and perhaps dominant, influences of the credit made via other aspects of the investment decision are ignored.

The best study so far of the effect of the investment credit on rate-of-return calculations^{is}_A by George Teborgh. The following comments summarize his approach and extend some of his calculations; consider the importance of some of his assumptions; and, finally, question the conclusion he draws from his study.

The general problem is to find the way in which an asset's rate-of-return (i) changes as a result of introducing the investment credit.⁸ The effect of the investment credit will be to give the investment opportunity a rate-of-return, s' . The implications of the credit then centre around a comparison of i and s' . In addition there is the question of discovering which parameters of the investment determine the extent of the difference

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Rate-of-return here means "internal-rate-of-return", that is, the rate of interest which equates the present-value of post-tax cash flows to the initial cost.

between i and s' .

The problem treated by Terborgh, of course, was not at this level of generality. His first step in cutting the problem down to manageable proportions was to work from the assumption that i is 10%; that is, before the credit is applied to the investment it has a rate-of-return on post-tax cash flows of 10%. Another simplifying assumption is that the earnings of the investment--pre-tax and pre-depreciation--are linear decreasing with time until they reach a value of zero. This period of time defines the life (n) of the investment. Finally, Terborgh excludes salvage value and assumes that the initial cost of the asset is depreciated by the 'sum-of-the-years' digits method (SOYD).

From these assumptions the pre-tax and pre-depreciation earnings may be written as:

$$(1) \quad R(t) = (n - t + 1)g \quad t = 1, 2, \dots, n.$$

where $R(t)$ is the earnings at the end of period t and g is simply the constant appropriate to the investment (describing the absolute decline per period in earnings). If the tax-rate is T (equal to .52) and SOYD depreciation is used then, if the asset is to earn a rate-of-return on post-tax cash flows equal to i , the following relation must hold:

$$(2) \quad C = \left[\sum_{t=1}^n (n - t + 1)h^t \right] [(1-T)g + \frac{2TC}{n(n+1)}]$$

where $h = (1+i)^{-1}$. This summation can be reduced to give the following

relationship:

$$(3) \quad \frac{ng}{C} = \frac{1}{1-T} \left[\frac{ni^2}{ni - 1 + h} n - \frac{2T}{n+1} \right]$$

If an investment credit (k) is available to the same asset then the net cost of the asset is $C(1 - k)$ and the depreciable base is $C(1 - k)$. Assuming that the other characteristics of the investment remain unchanged it is obvious that the new rate-of-return, s, is defined by an equation of the same form as (3) but with C replaced by $C(1 - k)$. Since the other characteristics remain unchanged it follows that ng/C must be equal for both of these equations. Hence:

$$(4) \quad \frac{1}{1-T} \left[\frac{ni^2}{ni - 1 + h} n - \frac{2T}{n+1} \right] = \frac{1-k}{1-T} \left[\frac{ns^2}{ns - 1 + u} n - \frac{2T}{n+1} \right],$$

where $u = (1+k)^{-1}$.

Actually it is impossible to solve equation (4) for s explicitly. As noted above Terborgh graphed the values for s assuming that i is 10% and allowing n to vary. Table 1, which tabulates the values of s corresponding to a fairly broad range of values for i and n, provides a more accurate and more complete picture of the numerical relationships.¹⁰

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The right-hand side of equation (2) is an arithmetic-geometric series which can be summed by employing the usual formulae found in text-books on algebra.

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See Terborgh's New Investment Incentives, chart 1, p. 4.

Table 1 shows that no matter what the pre-investment credit rate -of-return (i) is the post-investment credit rate -of-return (s) is always greater but never by more than three or four percentage points. The greatest impact of the credit is for assets with lives of eight years. The row for $N = 8$ is a row of maxima. Typical maximum changes are:

if $i = 10\%$ the maximum value of s is 11.7%,

if $i = 15\%$ the maximum value of s is 17.01%,

if $i = 25\%$ the maximum value of s is 27.64%.

Hence relative changes are of the order of 17%, 13.4% and 10.5%. Thus the relative impact of the investment credit decreases not only with the asset's age (beyond eight years, for a given i , s falls rapidly at first with increasing n but decreases very gradually after $n = 15$) but also with respect to pre-credit profitability. The credit makes the less profitable projects look relatively more profitable.

In these relative terms the effect of the investment credit looks very impressive and it was this way¹¹ of looking at its effect which led Terborgh to conclude that "the present credit effects a substantial improvement in the after-tax return".¹² Theoretically it is true that projects which are marginal (cost-of-capital equals i) without the benefit of the investment credit will be accepted if the credit is applied, since s is always greater than i . It does not seem likely that projects not acceptable (by comparing

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Ibid., p. 4, "in the important 10-15 year zone the return is raised from 10 percent to an average of around 11.4 percent. In other words, the return ~~is~~ goes up by 14 percent."

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Ibid., p.4.

(i with the cost-of-capital) would in practice become acceptable as a result of comparing s with the cost-of-capital, especially if the uncertainties in both s and the cost-of-capital are considered. In brief the investment credit, in so far as it affects rate-of-return computations, does not seem to be particularly influential.

It is interesting to consider whether these conclusions are at all sensitive to the assumptions made by Terborgh. The restrictions on the time shape of the earnings stream, $R(t)$, is probably the most interesting one to examine. Several projects for which $R(t)$ varied sharply from the assumption of linearly decreasing flows were constructed and the actual rates-of-return for them with and without the application of the investment credit computed. The relevant data are summarized in Table 2 and the results in Table 3. The cash flows of Table 2 are year-end magnitudes. Actually, for simplicity in calculation, they are post-tax cash flows. Since the objective here is to consider flows which deviate from the assumption specified by equation (1) it makes no difference whether the linearity is violated in pre tax flows ($R(t)$) or in terms such as $(1-T)R(t) + 2TC(n-t+1)/[n(n+1)]$, the after-tax cash flow in period t of the pre-tax earnings $R(t)$, assuming SOYD depreciation. A brief glance at the time shape of the cash flows of these projects indicates considerable variation from linearity.

Table 3 shows three different rates-of-return computed from the basic data of Table 2. First the actual rate-of-return on the projects (as specified in Table 2) and without applying the investment credit (i). Three of these projects have been standardized at the rate employed by Terborgh, 10%; project D, however, has a 15% rate-of-return. The

TABLE 2*

CASH FLOWS (\$000's)

PROJECT \ YEAR	YEAR								COST
	1	2	3	4	5	6	7	8	
A	10	10	10	10	10	10	10	10	53,349
B	10	20	40	90	90	10	10	10	188,468
C	7	7	3	3	—	—	—	—	16,452
D	80	80	80	20	10	10	—	—	203,388

*End of period magnitudes; post-tax cash flows, assuming SOYD depreciation is used.

TABLE 3

PROJECT*	LIFE (n)	RATE - OF - RETURN		
		WITHOUT CREDIT (i)	WITH CREDIT	
			ACTUAL (s')	TABULATED (s)
A	3	10.00	11.30	11.70
B	3	10.00	11.23	11.70
C	4	10.00	10.75	10.78
D	6	15.00	16.63	16.50

*See description of projects Table 2.

application of the investment credit, of course, to each of the four projects gives an increased rate-of-return, s' . Considerable relative variation between s' and i exists; for example, a 13% increase for A, and a 7-1/2% increase for C. Finally, the rate-of-return s is listed (from Table 1) for each project. As noted above a value for s can be assigned to each project if the life (n) and the pre-credit rate-of-return (i) are known and the cash flow is assumed to decrease linearly with time.

Despite the considerable deviation from the linearity assumption there is considerable agreement between the values for s and s' . Thus the apparently limiting assumption built into Terborgh's formulae does not seem to be too important. So long as the pre-credit rate-of-return (i) is known the actual rate with the credit is at most only one or two percentage points above the pre-credit rate and very little different from the theoretical values of the post-credit rate with the linearity assumption included. While s and s' are of necessity greater than i , s' may be greater or smaller than s depending on the nature of the deviation of the flows from the linear assumption.

The payback period (p) of an investment is defined¹³ by the following equation:

¹³

There are many variants of the payback criterion. The one used here is the number of years required to equate after-tax cash flows to the initial cost.

$$(5) \quad (1-T) \sum_{t=1}^p R(t) + TC \sum_{t=1}^p d(t, n) = 0$$

where T , C , and $R(t)$ are as defined above and $d(t, n)$ is the depreciation, per dollar of depreciable base, in period t for an n -year investment. If this asset enjoyed the benefits of the investment credit its payback period would be q as defined by equation (6):

$$(6) \quad (1-T) \sum_{t=1}^q R(t) + TC(1-k) \sum_{t=1}^q d(t, n) = C(1-k).$$

What is the relationship between p and q ? In general this is a difficult question to answer. A partial answer may be had as follows: eliminating the variable C between equations (5) and (6) the following relationship is found:

$$(7) \quad \sum_{t=1}^q R(t) = (1-k)(1-T \sum_{t=1}^q d(t, n)) (\sum_{t=1}^p R(t)) / (1-T \sum_{t=1}^p d(t, n))$$

For the simple case of straight line depreciation and constant earnings, R , the post-credit payback may be expressed in terms of the pre-credit payback thus:

$$(8) \quad q = np(1-k)/(n-Tkp)$$

From equation (8) it follows that the larger the investment credit (k) the more impact it has, that is, the shorter the new payback period (q). The stimulant k will also be more effective with respect to longer lived assets and less effective for those having high pre-credit payback periods. For example, a five year asset which has a payback period of 4 years before the investment credit (p) would have its payback period reduced to 3.94 years (q). A 10 year asset for which p equalled 5 years has a q -value of 4.74 years. These examples, though not definitive, tend to support the conclusions reached in the earlier discussion on the rate-of-return, namely, that the investment credit is not particularly effective in so far as it reacts upon the criterion measuring the investments worth in this case, the payback period.

APPENDIX A

INVESTMENT CREDIT PROVISIONS

The details concerning the method of calculating the investment credit and the conditions in which it is applicable are not particularly complicated. Section Two of the Revenue Act of 1962 is the basic source which the interested reader should consult. A useful summary of the reasons advocated for the introduction of the investment credit is provided by Secretary of the Treasury, Douglas Dillon.¹⁵

The essential provisions of the investment credit are that the credit varies with the life of the investment and that the amount of the credit is deducted from the asset's depreciable base. The purchase of a \$1,000 piece of equipment which has a 10 year life yields a tax credit of \$70 which is deducted from the corporation's tax liability. Assuming a zero salvage value the amount which the corporation may then depreciate is \$930. Thus the investment credit involves a positive factor--the reduction of taxes (not quite immediately) when the asset is purchased; and a negative component--the loss of depreciable base (tax shield) spread over time. Intuitively it is obvious that the net effect of these two factors is positive. If C is the cost of the asset and k the credit then kC is the gain and TkC the undiscounted loss, where T is the tax-rate. Clearly the net

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discounted effect requires further assumptions concerning the depreciation schedule, etc.

The law provides the following schedule for k:

for lives of 6 or 7 years k is $\frac{2}{3}$ of .07,

for lives of 4 or 5 years k is $\frac{1}{3}$ of .07.

Assets having lives of less than 4 years receive no credit; those having lives of 8 or more years receive the full 7% credit. This schedule, however, is not applicable to public utilities.

Where the new asset is acquired and at the same time an old one is traded-in the credit is applied to the net investment. Clearly the credit in any given year cannot exceed the tax-liability for that year. Carry-back and carry-forward provisions to the extent of three and five years respectively are available to the corporation so that it can exercise the availability of the credit. Another restriction is that if the tax credit exceeds \$25,000 the corporation can receive only \$25,000 plus 25% of the excess. The balance of the credit is, however, available through the carry-forward/carry-back provisions noted above.

37 '70

DEC 14 '70
DEC 14 '70

APR 22 '72

2 '74

JAN 11 '75

